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The effects of self-regulation techniques on human functional states: The moderating role of dominant sensory modality

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The application of self-regulation techniques forms a long tradition in Russian work and organizational psychology. The recent research line in this domain focuses on the elaboration of multilevel health promotion programs that provide for efficient learning of self-regulation skills and enlarge individual repertoires of coping strategies. Obtained data allowed to extract two main principles of self-regulation programs' adaptation: 1) taking into account the grade of fit between self-regulation means and the nature of human functional states' (HFS) negative transformations in work process; 2) acceptance of individual sensitivity to various self-regulation means. An individualized approach in using self-regulation techniques promotes higher effectiveness in their application and can be considered as a promising way for improving HFS and human reliability in different work settings. This paper investigates dominant sensory modality of imagery as one of individual traits on which selection of the most adequate and individually efficient self-regulation technique depends.

Key words: self-regulation, human functional state (HFS), dominant sensory modality, imagery

Typical changes in the general structure of the work domain in recent years reflect the following main tendency: the dominance of the physical workload, as well as the physical components of work execution, decreases (Blackler, 1988; Hockey, Gaillard, & Burov, 2003). There are several characteristics of main trends in the domain of the modern work development that are typical for general and rapid changes in the objective organizational structures and subjective perception of work in the modern society: growth of information flow as a crucial part of the work process, change towards the increase of the part of the so called mental work, rapid implementation of new information technologies, changes in time and space relations during the work process realization (Algera, 1988; De Keyser & Leonova, 2001; Meijer & Roe, 1993; Salvendy, Sauter, & Hurrel, 1987).

These tendencies manifest themselves in the decrease of physical efforts and the parallel increase of cognitive and emotional complexity of work (Bodrov, 2000; Chmiel, 2000; Cox & Fergusson, 1994; Cooper & Payne, 1988; Leonova, 1993; Roe, Zijlstra, Leonova, & Krediet, 1999). Mental effort dominates and, consequently, leads to the restructuring of cognitive regulatory systems involved in the work regulation in a rather complicated manner (Leonova, 1998). As work complexity grows, psychological factors of subjective acceptance, and redefining of objective work tasks and characteristics increasingly determine work outcomes (Leonova, 1998; Woods, 1988).

Work self-organization requires stronger efforts in order to resist different work stressors (Leonova, 1996; Marsella, 1994). Difficulties of the individual adaptation to the rapidly changing and demanding work environment lead to deterioration in health, which is usually "the price to pay" for the additional mobilization of psychological and psychophysiological resources (Cooper & Payne, 1988; Karasek & Theorell, 1990; Salvendy, Sauter & Hurrel, 1987).

It is possible to assume that the capacity to maintain adequate level of resources involved in work process helps work effectiveness. Thus, a promising way of work-related psychological support is to elaborate and to implement training programs targeted to teaching people how to manage their functional states at work.

The concept of human functional state (HFS) is one of the central concepts in the Russian work and organizational psychology (Leonova, 1994). It reflects and stresses out the relation between individual resources involved in work and work efficiency. HFS is defined as an integrative pattern of work-activated functions and abilities, which determine the

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efficiency of job performance under the actual work content and circumstances (Leonova, 1994, 2003). The theoretical framework of HFS research is based on the job analysis in order to distinguish between the sets of work situation factors leading to changes in HFS; current HFS is always viewed as a structural pattern of actualized physiological and psychological resources involved in the work execution. As the examples of different HFS some positive states could be mentioned, such as work functional comfort, adequate mobilization (for instance, in the sport competitions), as well as some negative HFS examples - stress, fatigue, monotony etc.

It is important to say that according to its definition HFS manifests itself on different levels: energetic level of activity regulation, operational level of cognitive functioning, reflective (or self-evaluative) level, and the resulting level of work performance and behavior (De Keyser & Leonova, 2001; Leonova, 1994). It means that investigating HFS needs multidimensional assessment, and sets of different HFS indicators should be examined in order to show shifts in various HFS manifestations and the functional structure of the work activity (Leonova, 1989, 2003). The format of the present article does not allow discussion of all the details of HFS theoretical and methodological approach, but references can be made to several examples of HFS empirical studies presented in the series of recent publications (De Keyser & Leonova, 2001; Hockey, Gaillard & Burov, 2003; Leonova, 1993, 1994, 1998; Roe, Zijlstra, Leonova, & Krediet, 1999).

As it was mentioned above it is useful to improve work performance through the psychological training in HFS management. In the Russian psychology a strong tradition exists concerning the application of the *psychoprophilactic* approach to HFS optimization (De Keyser & Leonova, 2001; Dikaya, 2003; Kuznetsova, 2004; Kuznetsova, Kapitsa, Blinnikova, Burmistrov, Belyshkin, & Firsov, 2001; Leonova, 2003; Leonova & Kuznetsova, 1993; Lobzin & Reshetnikov, 1986).

Developed in the Russian work and health psychology, HFS management approach is to some extent similar to the Western framework of stress-management, since stress is viewed as one of the HFS states. Among different HFS management methods self-regulation techniques form the most promising group with respect to: 1) active psychological position of the subject while using such techniques and 2) high usability of their actualization when necessary - a person can use them at any time and in any place, when and where it becomes necessary. HFS self-regulation methods are based on special regulatory skills as internal psychological habits of HFS transformations from non-optimal to appropriate/optimal state (Dikaya & Semikin, 1991; Leonova, 1993; Leonova & Kuznetsova, 1993). They include various means of relaxation and subsequent mobilization of resources, which are required by the nearest work/activity tasks.

A number of well-known techniques could be used as methods for psychological HFS self-regulation, such as the *progressive relaxation* (Jacobson, 1938), the *autogenic training* (Schultz, 1983) and some additional methods based on the similar main principles, namely *ideomotor training* and *visualization* (Barabanshchikova & Kuznetsova, 2003; Kuznetsova, 2004; Leonova & Kuznetsova, 1993).

It is important to clarify the main flow of HFS dynamics while using such self-regulation methods. The principal common trait is the development and the reflection of a special state - a state of lower level of consciousness, or the relaxation state. There is a lot of information on *physiological mechanisms* underlining the process of transformation from an initial HFS to the relaxation state (Kuznetsova et al., 2001; Lobzin & Reshetnikov, 1986; Luthe, 1969). When *psychological mechanisms* of changes are concerned, there are only a few investigations, mainly due to some objective difficulties within the research process: it is not possible to study peculiarities of psychological functioning (for instance, attention, memory, thinking, perception and so on) when subjects are in the state of relaxation. Deep plunging into oneself and the exhausting focusing of attention on one's own manifestations of the state are a typical feature of the relaxation state, so any communication with a relaxing person is interruptive. Self-reports and instrumental investigations become possible only after leaving a relaxation state, but not during this period.

An experimental investigation of changes in the complexity of physiological and psychological functions regarding the relaxation training has been conducted in several empirical studies in different occupational groups (Kuznetsova, 2004, Kuznetsova et al., 2001; Leonova, 1993; Leonova & Kuznetsova, 1993). Results of these studies can be summarized as follows. During the self-regulation training relaxation exercises are gradually transformed into the special internal skills, or the self-regulation habits. Their systematic use helps to protect human health by minimizing the effects of the occupational stress.

Clear positive dynamics of the actual HFS can be achieved using all the methods of self-regulation, applied to employees in various occupations. Statistically, optimizing a negative HFS through application of self-regulation procedures is effective in general, but there are substantial differences between the subjects' results. Some participants show only moderate improvement of HFS, while others are performing considerably better.

Differences were found in the type of actual effects of different self-regulation techniques - they are distinct with the respect to strong influence of self-regulation training on the occupational specificity in the negative HFS development. Systematic self-regulation training leads to a wide range of stable (prolonged) optimization effects. The positive effects of self-regulation are manifested mainly through those components of HFS regulatory processes that are basically influenced by work environment and workload.

The level of optimization effect is different depending on the type of the self-regulation techniques. In preventing various negative consequences of the work load it is more efficient to use techniques fitted for the dominant type of deterioration in the activity regulation of different occupational groups.

The main practical conclusion coming from the many years of experience with the self-regulation programs and their implementation in different work domain is: it is necessary to make special adaptation to different job conditions in order to increase positive effects, and to avoid negative transitions in job performance, well-being and health.

The fit between occupational specificity in HFS transformations and the self-regulation techniques is the first principle of the self-regulation programs' adaptation. The second one is the acceptance of individual specificity. It consists of the identification of individual differences, which accounts for the varying efficiency of different self-regulation methods. An individualized approach in using self-regulation techniques promotes their better application and is a potentially promising way of increasing human reliability and maintaining an optimal HFS in different work settings. Despite the common opinion that all self-regulation techniques are effective in developing inner regulation habit, it seems useful to find the basic lines of individualized adaptation. The question is which individual traits, or characteristics, should be taken into account when recommending the most appropriate combination of self-regulation methods.

Among various individual traits the dominant sensory modality of imagery seems very promising to us (Barabanshchikova & Kuznetsova, 2003). The point is that all self-regulation and relaxation techniques are different with the respect to the type of basic exercises, and these exercises are connected with various areas of human imagery. Progressive relaxation exercises address kinesthetic modality of imagery by forming sensations of warmth and heaviness in the body; sensory reproduction exercises are targeted to the reconstruction of visual image of a relaxing situation involving the visual modality (Benson, 1999; Everly & Rosenfeld, 1981; Jacobson, 1978; Kuznetsova et al., 2001; Mitchell, 1977; Leonova, 1993; Luthe, 1969). Therefore, the aim of the present study was to test the hypothesis, that the dominant sensory modality of human imagery determines, to part at least, the outcome of the self-regulation techniques' application.

Attention must be given to the concept of "dominant sensory modality of imagery". As can be seen in the psychological literature imagery itself is polymodal (Hilgard, 1977). Thus, various sensory modalities should be integrated in the complete image. We assume that one modality will be dominating, while other modalities play an instrumental role in the imagery constructing.

METHODS

Participants

Two studies of participants' dominant sensory modality and its role in HFS optimization were conducted. University students (N=257; 17 males), aged 19 to 30, participated in the first study. All participants responded to the Marks' questionnaire (see *Measures* for details). Those demonstrating extremely high vividness of imagery corresponding to one of the sensory modalities were selected - so the final sample consisted of 131 (8 males) students, aged 19 to 28. These participants were divided into two groups according to their dominant sensory modality: visual group (n=73) and kinesthetic group (n=58).

In the second study the investigated group consisted of 16 athletes (12 male), aged 21 to 28, all members of Russian Olympic team. Nine of them represented the judo team, seven represented the boxing team. These sports were chosen because of the peculiarities in the activity structure of these sports. In judo athletes pay most attention to kinesthetic feelings as the special type of partner's feedback. On the other hand, boxers take into consideration mainly visual signals that control their athletes' activity. Following on that (Ananyev, 1961), we assumed that early and extensive sport specialization exerts major influence on young sportsmen' imagery development. Most vivid images evoked by highly qualified athletes are of that sensory modality, which is actualized by the sport exercised (Kudo, 1982). All athletes filled in Marks' questionnaire. The results supported our hypothesis. The dominant modality of all judo athletes was kinesthetic, and of all boxers – visual.

Measures

1. Questionnaire-based assessment of the dominant sensory modality was used to assign participants into groups. The questionnaire is based on the various imagery-oriented tasks (such as imagining a known face or imagining the feeling of warmth and heaviness in the body) that permit subjects to create images in different modalities (Marks, 1999; Lequerica et al., 2002). The indicator of sensory modality dominance is the vividness of the created image. After completion of each task all participants were asked to describe the vividness of the evoked image (in accordance with the suggested scale). Sensory modality, which was represented more vividly, was determined as the dominant one for that participant. Some of the participants could not represent any images vividly enough. These participants were excluded from the subsequent stages of the study.

2. Current HFS of the participant was measured before and after application of each of the self-regulation method by a multi-level set of HFS indicators, including measures

Table 1

HFS estimation

Levels	Measures	Indicators
Psychological level	Well-being scale (Doskin et al., 1973)	Subjective comfort Activity Mood
	State anxiety scale (Spielberger, 1990)	State anxiety
Physiological level	Blood pressure	Systolic and diastolic
	Heart rate	Pulse Kerdo index
Task performance	Burdon's test (De Keiser & Leonova, 2001)	Productivity and accuracy

of checking task performance (indicators: productivity and accuracy); well-being scales (indicators: state anxiety, subjective comfort, activity, mood); physiological measures – heart rate and blood pressure (indicators: systolic and diastolic blood pressure, pulse, vegetative Kerdo index) (see Table 1). Such three-level estimation is considered to provide a complete and structural description of HFS (Leonova, 2003).

Self-regulation methods

Each participant tried two types of self-regulation methods (progressive relaxation and sensory reproduction). For this study we have chosen the most effective self-regulation procedures. The difference between these two self-regulation programs consists in the type of exercises included in the relaxation session. These exercises are related to different imagery modalities: those from progressive relaxation method relay primarily on kinesthetic images; those from sensory reproduction method make extensive use of visual images.

Procedure

Each study consisted of two stages. The purpose of the first stage was to identify participants who had dominant visual or kinesthetic imagery modality. These participants than participated in the next stage in order to test the hypothesis, that there is an interaction between the type of dominant sensory modality and the efficiency of different self-regulation methods: progressive relaxation and sensory reproduction.

All participants took part in the two relaxation sessions. In each session, different self-regulation method was used. There was a 7-days pause between the two relaxation sessions, thus, there was a small chance of interaction effects between both relaxation methods. The order of self-regulation methods was counterbalanced, controlling for the possible order effects. Current HFS was measured twice: before and after each self-regulation session. All analyses were performed using SPSS for Windows.

RESULTS

Descriptive statistics of both studies is presented in Table 2 and Table 3, respectively.

As t-test shows, a difference is found in the vividness of the visual images' between the two groups. Vividness was significantly higher in the visual group ($N = 131$, $t = 13.281$, $p < .001$). The results are reversed for the kinesthetic imagery: results are higher in participants in kinesthetic group ($N = 131$, $t = -10.807$, $p < .001$). The same comparison was

Table 2

Descriptive statistics (students)

	Progressive relaxation								Sensory reproduction							
	Visual group (*n*=73)				Kinesthetic group (*n*=58)				Visual group (*n*=73)				Kinesthetic group (*n*=58)			
	Before		After		Before		After		Before		After		Before		After	
HFS indicators	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Subjective comfort	4.8	1.1	4.9	1.19	4.9	0.86	5.3	0.85	4.9	1.15	5	1.06	4.8	1.2	4.9	1.16
Activity	4.5	1.03	4.2	1.37	4.6	1	4.8	1	4.6	1	4.6	1.17	4.6	1.3	4.5	1.26
Mood	5.2	1.27	5.4	1.25	5.4	0.93	5.7	0.97	5.3	1	5.5	0.86	5.1	1.3	5.3	1.22
State anxiety	39.49	9.66	36.38	11	39.81	8.5	34.59	7.3	38.7	9.3	34.86	6.9	41.4	11.9	38.55	9.8
Systolic	115	10	112	10	115	10	114	10	115	10	113	10	115	10	112	10
Diastolic	77	10	75	10	75	10	74	5	75	10	73	10	75	10	73	10
Pulse	79	12	75	12	82	13	80	10	77	14	74	12	78	12	77	12.4
Kerdo index	-0.25	18	-1.62	18	7.56	16.7	4.36	15.3	-0.78	21	-0.99	18	1.5	16	2.36	20
Productivity	237	59	245	63	228	67	250	60	289	89	282	78	273	78	267	70
Accuracy	0.88	0.12	0.87	0.13	0.86	0.16	0.9	0.13	0.89	0.11	0.9	0.1	0.9	0.11	0.9	0.1

Table 3

Descriptive statistics (athletes)

	Progressive relaxation								Sensory reproduction							
	Visual group boxing: (*n*=7)				Kinesthetic group: judo (*n*=9)				Visual group boxing: (*n*=7)				Kinesthetic group: judo (*n*=9)			
	Before		After		Before		After		Before		After		Before		After	
HFS indicators	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Subjective comfort	5.3	0.62	5.7	0.77	5.05	0.9	5.1	0.88	5.5	0.74	5.5	0.54	4.3	1.5	4.8	1.1
Activity	4.9	0.92	5.2	1.14	4.89	0.77	4	1.2	5.2	0.89	5.1	1.3	4.2	1.5	4.2	1.3
Mood	5.9	0.73	6.1	0.63	5.59	0.85	5.8	0.59	5.6	0.57	6.0	0.54	5	0.9	5.4	0.93
State anxiety	32.29	8.75	27.86	6.2	34.67	5.4	30.33	6.6	33.14	7.2	30.71	8.5	35.78	8	34.33	7.4
Systolic	132	15	125	10	126	10	121	10	133	10	125	10	122	15	115	10
Diastolic	90	5	85	10	83	5	80	5	92	5	85	5	77	15	78	5
Pulse	76	17	70	19	58	5	61	9	67	11	64	10	64	10	61	10
Kerdo index	-25.65	34.8	-31.72	39.2	-43.33	18.1	-34.93	27	-40.34	24.4	-35.25	23	-25.7	42.1	-32.23	31.3
Productivity	174	78	179	67	220	53	221	53	212	65	189	38	255	57	238	49
Accuracy	0.84	0.13	0.89	0.08	0.93	0.06	0.86	0.1	0.91	0.06	0.86	0.09	0.94	0.05	0.93	0.07

performed for the second investigated group - athletes. Obtained results matched the students' results (*n=16, U=6.5, p <.01 (boxing): n=16, U=11.5, p <.05 (judo*)). Relying on these results corresponding to the first stage of our study, the second stage data were analyzed.

Group comparisons (paired t-tests) of students' HFS indicators revealed that, for the visual group, complete positive effect was induced by the method of sensory reproduction (p <.05), and in the kinesthetic group, complete positive effect was associated with the method of progressive relaxation (p <.05). The deviation from this tendency was found only for physiological measures. They were optimized in all cases after both self-regulation sessions. All data are presented in the Table 4.

To assess possible modality congruency effects in an alternative way, repeated measures 2×2 ANOVAs on pre-post shifts of HFS indicators were performed separately on students' data. The two factors used were GROUP (visual/kinesthetic) as a between-subjects factor and METHOD (sensory reproduction/progressive relaxation) as a within-subjects factor. The ANOVAs showed no significant results except for the task accuracy. In the last case no main effects was found, but we found a significant GROUP × METHOD interaction (F (1, 258) = 12.87, p <.001).

As for the athletes' results, we concluded that boxers were more receptive to the sensory reproduction effects because of the two important facts. The state self-assessment, as measured by the well-being questionnaires, decreased significantly after the progressive relaxation session. Sensory reproduction had an influence on job performance indicator, i.e. task accuracy, which is one of the most stable state characteristics.

Table 4

The efficiency of self-regulation methods (students, paired *t*-test)

	Indicators	Progressive relaxation		Sensory reproduction	
		Visual group (*n*=73)	Kinesthetic group (*n*=58)	Visual group (*n*=73)	Kinesthetic group (*n*=58)
Well-being scales	Subjective comfort	-1.1*	-3.5**	-0.8	-0.6
	Activity	2.1	-1.1	0.4	0.6
	Mood	-1.6	-2.3*	-2.2*	-1.2
	State anxiety	3.7**	5.6**	5.3**	2.4*
Blood pressure	Systolic	2.3*	0.5	1.3	2.6*
	Diastolic	2.4*	0.7	2.2*	1.6
Heart rate	Pulse	3.1*	2.4*	2.7**	0.4
	Kerdo index	0.7	1.4	0.1	-0.3
Job performance	Productivity	-1.3	-3.5**	1.03	0.8
	Accuracy	1.1	-3.2**	-1.9*	0.6

Note. ** p <.01; * p <.05.

Table 5

The efficiency of self-regulation methods (athletes, *Wilcoxon* signed ranks test)

		Progressive relaxation		Sensory reproduction	
	Indicators	Visual group: boxing (*n*=7)	Kinesthetic group: judo (*n* =9)	Visual group: boxing (*n* =7)	Kinesthetic group: judo (*n* =9)
Well-being scales	Subjective comfort	-2.1*	-0.1	-0.4	-1.7
	Activity	-1.4	-1.5	-0.2	-0.4
	Mood	-0.6	-1.1	-2.2*	-1.6
	State anxiety	-2.4*	-2.0*	-1.7	-0.9
Blood pressure	Systolic	-2.1*	-1.4	-2.2*	-1.3
	Diastolic	-1.9	-1.2	-2.3*	-0.4
Heart rate	Pulse	-1.4	-0.9	-1.4	-1
	Kerdo index	-0.7	-1.0	-1.3	-1
Job performance	Productivity	-0.5	0.0	-0.7	-1.2
	Accuracy	-1.6	-2.3*	-2.1*	-0.1

Note. ** $p < .01$; * $p < .05$.

Another situation can be observed in the judo group. Progressive relaxation had more distinct effect in this group: after this self-regulation method we noted significant changes in task accuracy (see Table 5). After a sensory reproduction session no significant effects were observed in this group.

DISCUSSION

The first stage of both studies allowed us to determine participants' dominant sensory modality, visual vs. kinesthetic. It's very important to note that all subjects used their dominant sensory modality as the starting point in the construction of the polymodal image, in accordance with their self-reports and Marks' questionnaire results. Thus, our data could prove the hypothesis about functional nature and instrumental role of such psychological concept as "dominant sensory modality of imagery".

The results indicate that in almost all self-regulation sessions the physiological indicators of HFS have improved. It means that both self-regulation procedures can optimize physiological level of HFS manifestation independently of the participants' dominant sensory modality (Brigham, 2003; Huber & Gramer, 1990). But other measures of HFS were changed in accordance with the dominant modality demands.

Students' results

The results show that progressive relaxation has a more distinct effect on the participants in the kinesthetic group, and has no strong effect on the participants of the visual group. On the other hand, sensory reproduction has a more distinct effect on the participants with a dominant visual modality. This conclusion is based on the HFS analysis methodology: a change in HFS is registered when all state indices change values significantly (Leonova, 1996; Leonova, 2003). Also, as the ANOVA results on the task accuracy shift show, improvement of job performance depended on the predicted combination of the dominant modality and self-regulation method.

It must be mentioned that self-regulation techniques include different types of imagery exercises. Progressive

Table 6

Complex interpretation of students' t-test data (according to HFS methodology)

	Progressive relaxation		Sensory reproduction	
	Visual group (*n*=73)	Kinesthetic group (*n*=58)	Visual group (*n* =73)	Kinesthetic group (*n* =58)
Well-being scales	Negative decrease or no changes	Positive strong increase	Positive increase	Positive increase or no changes
Physiological measures	Positive decrease	Positive decrease or no changes	Positive decrease	No changes
Job performance	No changes	Positive strong increase	Positive increase	No changes

relaxation allows participants to create kinesthetic images. Sensory reproduction is based on representing images in the visual modality. There were no negative effects in the obtained data when kinesthetic group participated in the sensory reproduction training and when visual group participated in the progressive relaxation. As there were no positive changes too, we conclude that HFS in these cases remained the same. This is probably the effect of a single application, but exactly this unusual self-regulation technique showed the dominant sensory modality effect.

We had no intention to develop the special self-regulation skills of our participants. We wanted to check how a trait, such as the dominant sensory modality of imagery which is well-known but less investigated in psychology, can determine the outcome of using the self-regulation techniques. So it was important to investigate the "clear" interaction between such imagery peculiarities and self-regulation efficiency without any recreation learning effect.

Thus, our hypothesis that dominant sensory modality will define the effectiveness of such imagery exercise realization was confirmed in our students' group.

Athletes' results

Although our second investigated group – athletes – was not very large, the obtained results were similar.

The special activity of these participants is based on their high level of imagery development (Kudo, 1982; Mumford & Hall, 1985). The main difference consists in the kind of sport, which has its own special demands to the athletes' imagery.

As was shown in the Table 5 and Table 7, sensory reproduction has more distinct effect on boxers, and progressive relaxation – on judo athletes. It must be noted that these distinct effects were accompanied by a negative decrease of such state indicators such as accuracy. This is an important fact regarding the changing in the priorities of athletes' mind. It means that the congruent self-regulation method (according to the dominant sensory modality) makes participants change their inner activity to another task – their recreation. The previous activity becomes unimportant now, and the state self-estimate is taken as indicator of task performance in HFS system.

And exactly the changes in the checking of task performance shifts are a serious signal of self-regulation technique acceptance, because task performance and especially parameters such as accuracy are the most stable HFS characteristic (Barabanshchikova & Kuznetsova, 2003; Kuznetsova et al, 2001; Leonova, 2003).

Results' comparison

The data analysis shows that the dominance of different sensory modalities is conditioned primarily by the special participants' activity. The first investigated group consisted of 257 students. Their education is not connected with the usage of any special sensory modality. Only 131 participants in our sample had a dominant sensory modality – visual or kinesthetic.

In the athletes' sample everyone developed a dominant sensory modality of imagery. There were only 16 subjects, but all of them demonstrated high sports qualification. That is why we could conclude that dominance of some sensory modality depends also on the subject's activity. And in turn, a dominant sensory modality can be a special mechanism that determines professional development.

The students' data show a more clear interaction between the type of dominant sensory modality and the efficiency of the self-regulation technique. The data collected in athletes' sample reflect the same tendencies. A divergence in the results was observed for one task performance indicator – accuracy. It increased in the first case, and decreased in the second case. We believe it depends on the subjects' activity. For students it was more important to optimize their educational process. For athletes it was more important to optimize their inner state, so the task performance became less important.

CONCLUSIONS

Each of the groups in the study exhibited selective responsiveness to the HFS self-regulation techniques, which

Table 7

Complex interpretation of athletes' Wilcoxon-test data (according to HFS methodology)

	Progressive relaxation		Sensory reproduction	
	Visual group	Kinesthetic group	Visual group	Kinesthetic group
Well-being scales	Positive increase	Positive increase	Positive increase	No changes
Physiological measures	Positive decrease	No changes	Positive decrease	No changes
Job performance	No changes	Negative decrease	Negative decrease	No changes

is based on relaxation exercises corresponding to the dominant sensory modality of the participants. Thus, in the selection of the most appropriate self-regulation method the dominant sensory modality must be taken into account.

However, a number of objections can be given to the gathered data. On the one hand, this has to do with the multiple measurements of HFS variables. Thus, the confounding pretest effect is possible. This possibility is not so serious, if we keep in mind the nature of the indicators used. These are objective characteristics (physiological or task performance measures) or valid HFS indicators. It can hardly be seen how they can be systematically altered by a pretest measurement. More serious is the problem of increased Type I error. We decided not to use corrected significance levels due to the exploratory nature of this study.

On the other hand, for the students' data the experimental hypothesis was only partially confirmed, as the predicted modality congruency effect showed up only for task accuracy. It can be argued that the task performance measures are those demonstrating the relation between modality specificity and HFS. This is because self-estimates of HFS generally reflect the changes in a current HFS with some delay and in this particular sample of healthy young subjects physiological indicators altogether varied less.

Thus, future research in this domain should use more numerous samples. This would allow exploration of the hypothesis under the more stringent significance levels. Also, research with participants of various ages and with other dominant sensory modalities should be conducted. Another important line of research should consider the development of self-regulation techniques, taking into account various aspects of mental images.

On the base of our results we could also give some recommendations concerning the construction of HFS self-regulation training programs. First of all, it will be very important to decide what types of HFS self-regulation techniques are necessary. If it will be a short course of self-regulation – only some kind of presentation without any skill learning – it is recommended to use self-regulation methods in strict accordance with the dominant sensory modality of the participants so to obtain a more distinct effect. The long-time learning assumes the development of that sensory modality which is not dominant in order to provide participants with different coping strategies. This type of self-regulation learning makes people more stable and more stress-resistant in their emotional life.

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